

CLAIMS

What is claimed is:

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- 1 1. An apparatus, comprising:
- 2 an elongated source of a therapeutic agent to deliver a dose of the
- 3 therapeutic agent to a vessel, the source having gradients of therapeutic agent
- 4 concentrations near a proximal end and a distal end of the elongated source.
- 1 2. The apparatus of claim 1 wherein the gradients comprise therapeutic agent
- 2 concentrations gradually decreasing near the proximal end and the distal end of the
- 3 elongated source.
- 1 3. The apparatus of claim 1 wherein the source comprises a radioactive
- 2 intravascular stent.
- 1 4. The apparatus of claim 1 wherein the source comprises a radiation source wire.
- 1 5. The apparatus of claim 1 wherein the source comprises a drug delivery stent
- 2 having an anti-cell proliferation drug for treatment of the vessel.

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

1 6. An apparatus, comprising:
2 an elongated radiation dose delivery source having a radioactive region
3 thereon, the radioactive region having a proximal end and a distal end, a therapeutic
4 radioactivity level between the proximal end and the distal end, the radioactive region
5 also having regions of radioactivity gradients to transition from the therapeutic
6 radioactivity level to a non-therapeutic radioactivity level near the proximal end and the
7 distal end.

1 7. The apparatus of claim 6 wherein the radiation dose delivery source comprises
2 an intravascular stent.

1 8. The apparatus of claim 6 wherein the radiation dose delivery source comprises a
2 radiation source wire.

1 9. The apparatus of claim 6 wherein the therapeutic radioactivity level gradually
2 decreases to the non-therapeutic radioactivity level within the regions of radioactivity
3 gradients.

1 10. The apparatus of claim 6 wherein the radioactive region comprises a beta
2 particle emitting isotope.

1 11. The apparatus of claim 6 wherein the radioactive region comprises a gamma
2 particle emitting isotope.

1 12. The apparatus of claim 6 wherein the radioactive region comprises a beta
2 particle and a gamma particle emitting isotope.

1 13. A method, comprising:

2 providing an elongated radiation dose delivery source;

3 forming a radioactive region on the delivery source, the radioactive
4 region having a proximal end and a distal end, a therapeutic radioactivity level between
5 the proximal end and the distal end; and

6 forming regions of radioactivity gradients on the radioactive region near
7 the proximal end and the distal end, the radioactivity gradients transitioning from the
8 therapeutic radioactivity level to a non-therapeutic radioactivity level.

1 14. The method of claim 13 wherein forming the regions of radioactivity gradients
2 comprises uniformly decreasing the radioactivity level from the therapeutic level to the
3 non-therapeutic level.

1 15. The method of claim 13 wherein forming the regions of radioactivity gradients
2 comprises variably decreasing the radioactivity level from the therapeutic level to the
3 non-therapeutic level.

1 16. The method of claim 13 wherein forming the regions of radioactivity gradients
2 comprises decreasing the radioactivity level by incremental steps from the therapeutic
3 level to the non-therapeutic level.

1 17. The method of claim 13 wherein forming the radioactive region comprises
2 coating the delivery source with isotopes by ion beam implantation.

1 18. The method of claim 17 wherein forming the regions of radioactivity gradients
2 on the radioactive region comprises gradually decreasing an ion beaming time.

1 19. The method of claim 13 wherein forming the radioactive region comprises
2 coating the delivery source with isotopes by plasma implantation.

1 20. The method of claim 19 wherein forming the regions of radioactivity gradients
2 on the radioactive region comprises masking the proximal end and the distal end of the
3 radioactive region with radioactivity shields.

1 21. An intravascular stent, comprising:
2 a radioactive region along an elongated length of the stent to deliver a
3 radiation dose to a vessel wall, the radioactive region having an area of substantially
4 uniform radioactivity level to provide a therapeutic dose to the vessel wall, the uniform
5 radioactivity level localized near a central portion of the stent, the radioactive region
6 also having radioactivity level gradients near a proximal end and a distal end of the
7 stent, the radioactivity level gradients to decrease gradually the dose delivered to the
8 vessel wall from the therapeutic dose level to a non-therapeutic dose level, the gradients
9 to decrease from a point inward of the proximal end to or near the proximal end, and to
10 decrease from a point inward of the distal end to or near the distal end of the
11 radioactive region.

1 22. The stent of claim 21 wherein the radiation dose delivered to the vessel wall
2 inhibits vessel cell proliferation along the elongated length of the stent and past the
3 proximal end and the distal end of the stent.

1 23. The stent of claim 21 wherein the area of substantially uniform radioactivity
2 level comprises a greater longitudinal length than each of the gradients.

1 24. The stent of claim 21 wherein the gradients comprise a uniform rate of decrease
2 of radioactivity level.

1 25. The stent of claim 21 wherein the gradients comprise a variable rate of decrease
2 of radioactivity level.

1 26. The stent of claim 21 wherein the gradients comprise a decrease of radioactivity
2 level by incremental steps.

1 27. The stent of claim 21 wherein the radioactive region comprises a beta particle
2 emitting isotope.

1 28. The stent of claim 21 wherein the radioactive region comprises a gamma
2 particle emitting isotope.

1 29. The stent of claim 21 wherein the radioactive region comprises a beta and a
2 gamma emitting particle isotope.

1 30. The stent of claim 21 wherein the radiation dose comprises up to 60 Gray.

1 31. An intravascular stent, comprising:

2 a drug delivery region along a surface of an elongated length of the
3 stent, the drug delivery region having a variable drug concentration thereon to deliver a
4 drug dose to a vessel wall, the drug delivery region having an area of substantially
5 uniform drug concentration to provide a therapeutic dose to the vessel wall, the
6 substantially uniform drug concentration localized near a central portion of the stent,
7 the drug delivery region also having drug concentration gradients near a proximal end
8 and a distal end of the stent, the drug concentration gradients to decrease gradually the
9 dose delivered to the vessel wall from the therapeutic dose level to a non-therapeutic
10 dose level, the gradients to decrease from a point inward of the proximal end to or near
11 the proximal end, and to decrease from a point inward of the distal end to or near the
12 distal end of the drug delivery region.

1 32. The stent of claim 31 wherein the drug dose delivered to the vessel wall inhibits
2 vessel cell proliferation along the elongated length of the stent and past the proximal
3 end and the distal end of the stent.

1 33. The stent of claim 31 wherein the drug delivery region comprises a plurality of
2 indentations on the surface of the stent to accommodate a drug for the variable drug
3 concentration.

1 34. The stent of claim 33 wherein the substantially uniform drug concentration
2 comprises a uniform distribution of the plurality of indentations on the surface of the
3 stent near the central portion.

1 35. The stent of claim 33 wherein the concentration gradients comprise the plurality
2 of indentations on the surface of the stent to decrease gradually in distribution from the
3 central portion to the proximal end and to the distal end of the stent.

1 36. The stent of claim 33 wherein the proximal end and the distal end of the stent
2 comprise the plurality of indentations having decreased distribution compared to the
3 plurality of indentation near the central portion of the stent.

1 37. A method, comprising:
2 providing an elongated, intravascular drug source;
3 forming a drug region on the drug source, the drug region having a
4 proximal end and a distal end, a therapeutic drug concentration level between the
5 proximal end and the distal end; and
6 forming regions of drug concentration gradients on the drug region near
7 the proximal end and the distal end, the concentration gradients transitioning from the
8 therapeutic drug concentration level to a non-therapeutic drug concentration level.

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1 38. The method of claim 37 wherein forming the regions of drug concentration
2 gradients comprises uniformly decreasing the drug concentration level from the
3 therapeutic level to the non-therapeutic level.

1 39. The method of claim 37 wherein forming the regions of drug concentration
2 gradients comprises variably decreasing the drug concentration level from the
3 therapeutic level to the non-therapeutic level.

1 40. The method of claim 37 wherein forming the drug region comprises indenting a
2 surface on the drug source to accommodate a drug.

1 41. The method of claim 37 wherein forming the drug region comprises dipping the
2 drug source in a drug.

1 42. The method of claim 41 wherein forming the regions of drug concentration
2 gradients on the drug region comprises masking the proximal end and the distal end.

1 43. The method of claim 37 wherein forming the drug region comprises coating the
2 drug source with a drug.

1 44. The method of claim 43 wherein forming the regions of drug concentrations
2 gradients on the drug region comprises varying a translational drug spraying speed.

